3rd Integrated CNS Technologies Conference & Workshop

A Common Information Network for Aeronautical Communications

Mark S. Taylor

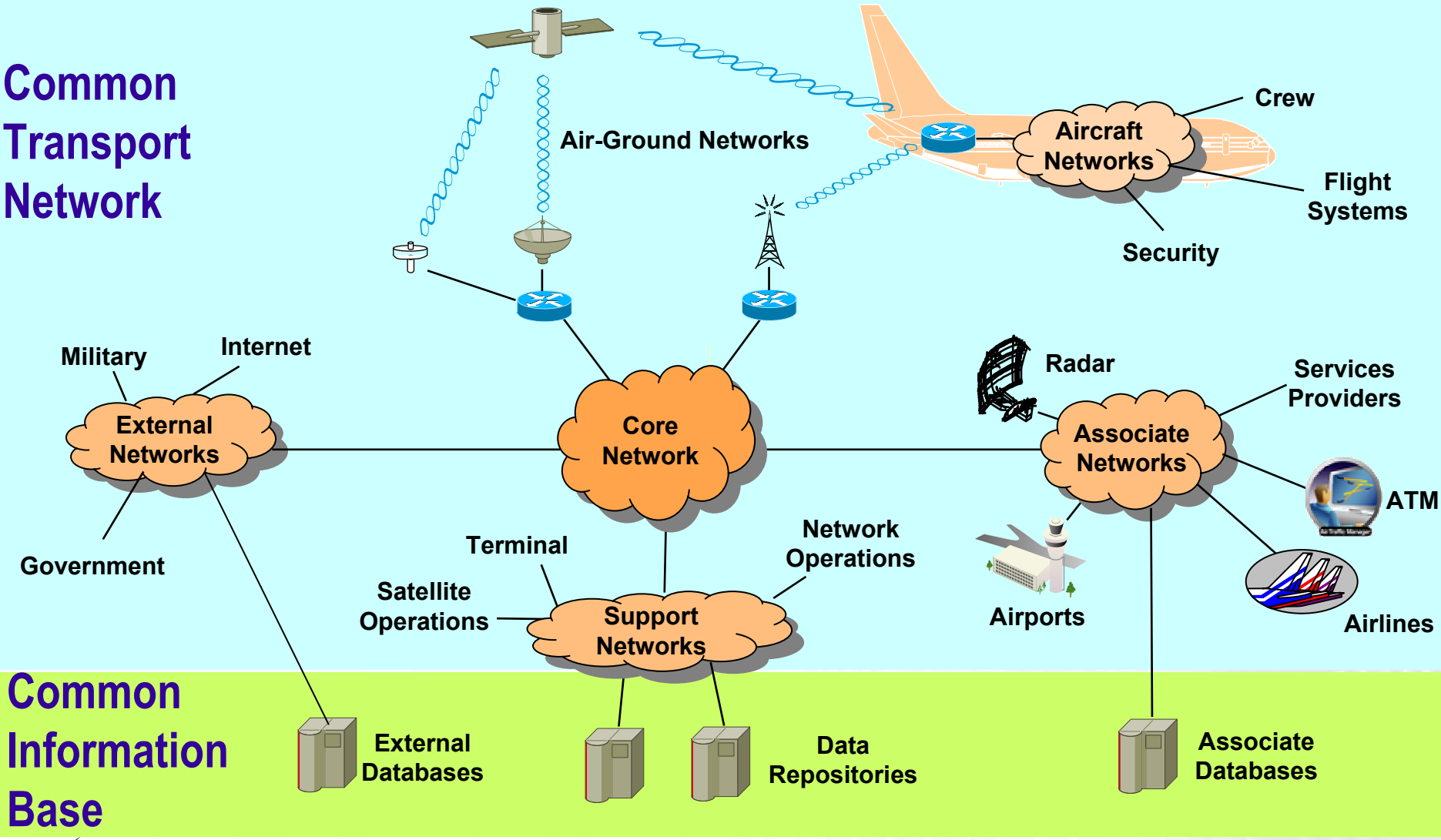
Avaliant LLC

20 May 2003

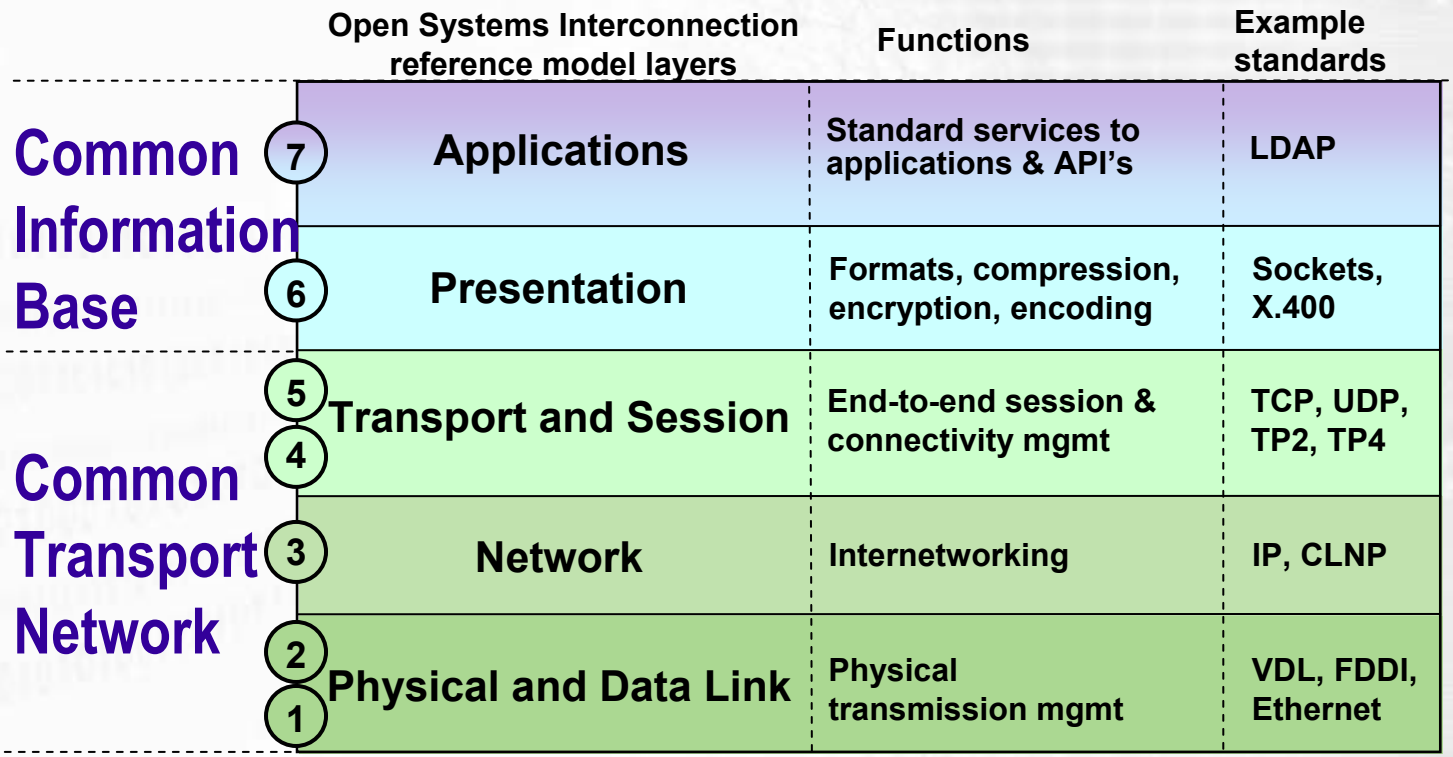
Presentation outline

- The CIN concept
- The current landscape
- Primary architectural considerations
- Architectural concepts
- Final thoughts

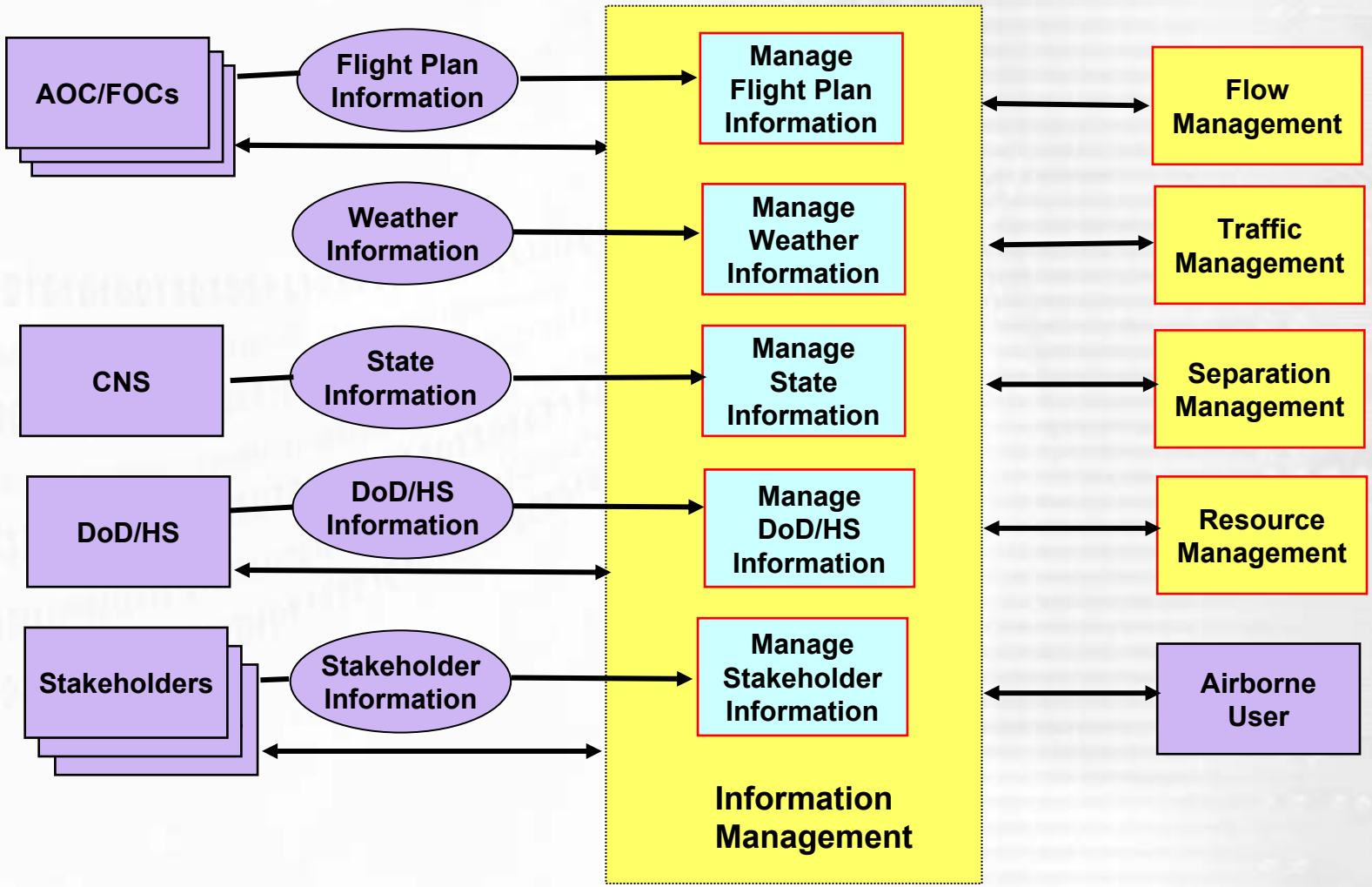
The CIN concept



The CIN concept – an open architecture



The CIN concept – information management



The current landscape

- Multiple network domains, owners and users:
  - Air traffic authorities
  - Airlines and aircraft operators
  - Data link service providers
  - Data services (weather, etc.)
- Multiple incompatible technologies:
  - VHF voice; VDL-2,3,4
  - ACARS
  - ATN
  - FTI
  - …

➔ ***Resistance to Change!***

The current landscape – ACARS

- Aircraft Communication Addressing and Reporting System (ACARS) provides air-ground data link services via VHF, SatComm and HF
  - Only currently widespread air-ground data link
  - SatComm-equipped aircraft switch between SatComm and VHF
- "ACARS" can refer to either:
  - Messaging function supporting CPDLC and ADS applications
  - Routing function gets messages to intended destinations
- Two companies offer ACARS services:
  - ARINC GLOBALink and SITA AIRCOM Datalink
  - CMS / MU controls preferences for ARINC or SITA
  - ARINC / SITA ground equipment queue one another as aircraft transitions from one data authority to the next data authority

➔ ***Resistance to Change!***

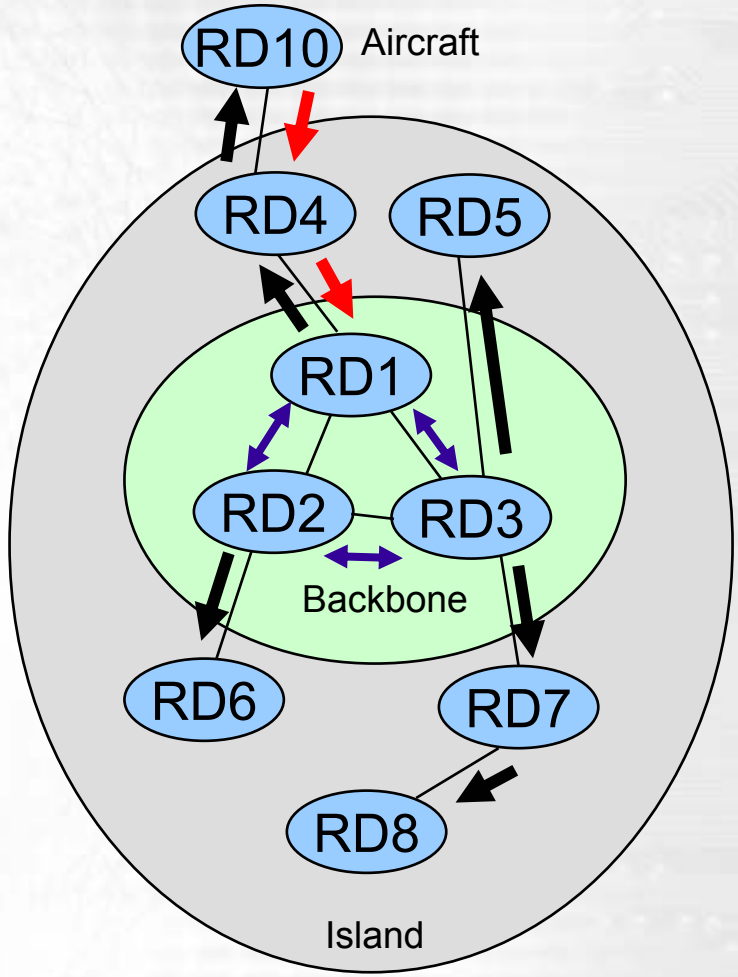
The current landscape – ATN

- Aeronautical Telecommunications Network (ATN):
  - In development by ICAO for over 15 years
  - Provides air-ground and ground-ground communications
  - Enhances CPDLC message set and other applications
  - Based on modified OSI data communication protocols
- ATN looks nice on paper, but…
  - OSI is legacy technology
  - Modifications mean nonstandard protocols
  - Non-COTS solutions are expensive, insecure and risky
  - Focus on air-ground link introduces Layer 3 disconnects
  - Mobility based on inter-domain routing convergence

➔ ***Resistance to Change!***

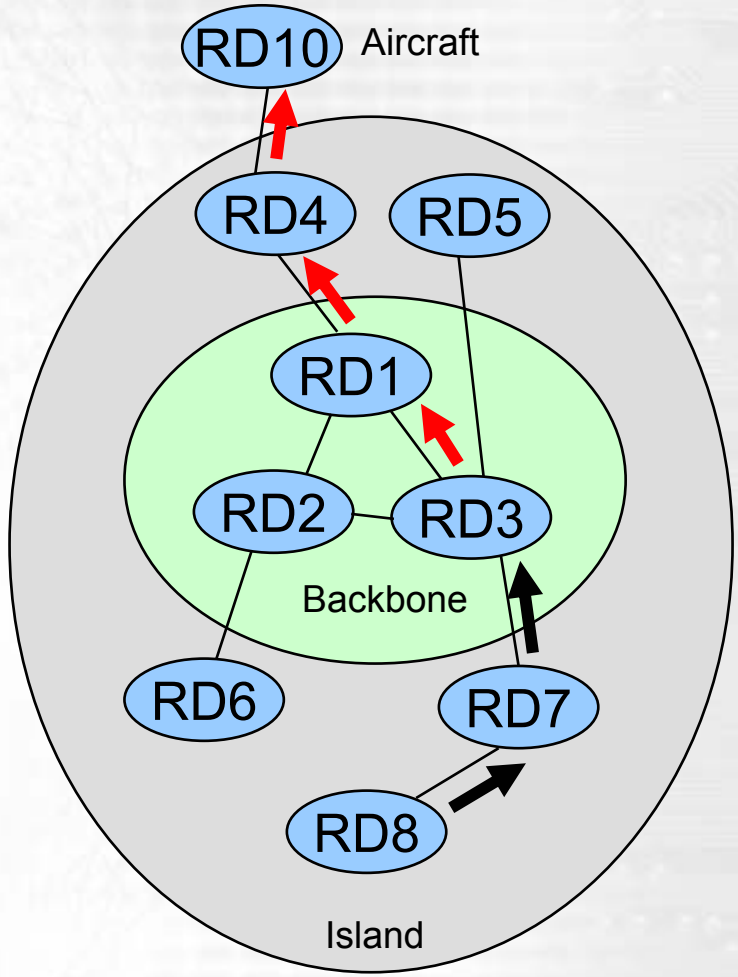
The current landscape – ATN mobility

- The backbone confederation advertises itself as the default route to the "**All Aircraft**" prefix
- Individual aircraft connect to the island and advertise their "**Specific Aircraft**" prefix
- Backbone domains are **updated** with the route to the specific aircraft prefix

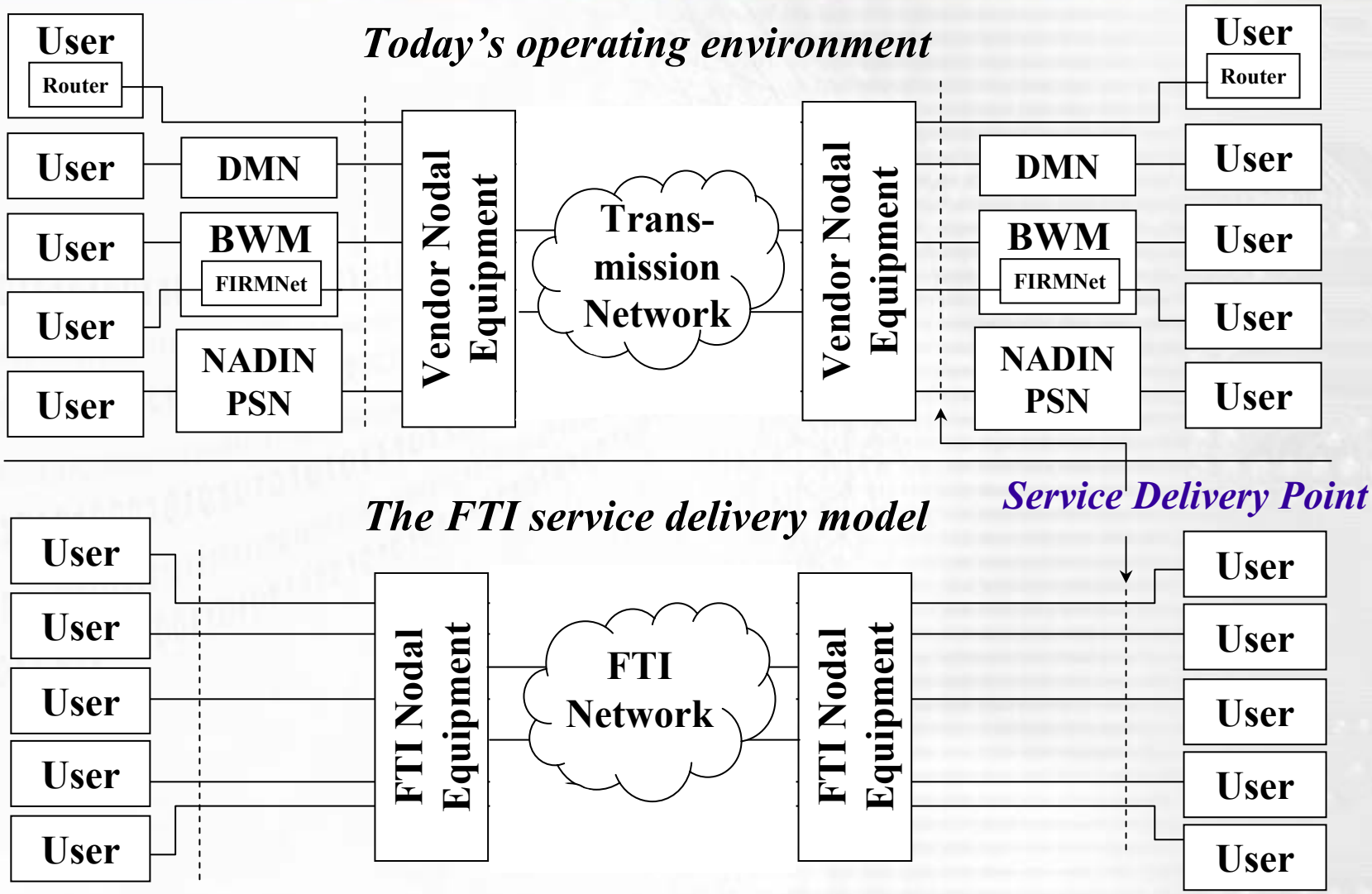


The current landscape – ATN mobility

- When a host needs to communicate with an aircraft, it sends all packets toward the default for "**All Aircraft**"
- Backbone and subsequent domains forward packets toward the "**Specific Aircraft**" prefix



The current landscape – FTI



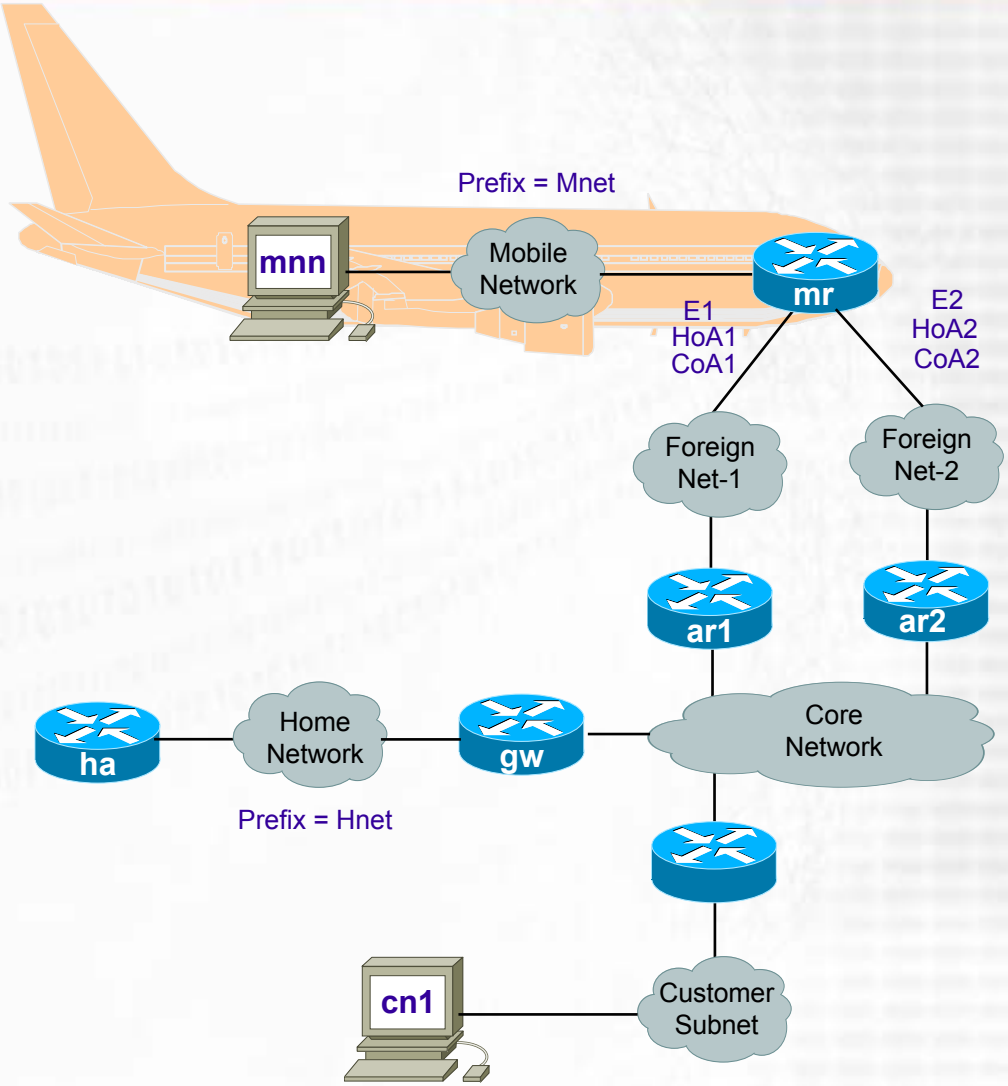
The current landscape – summary

Area of Comparison	ACARS (Current)	ATN (Future)	FTI (In deployment)	CIN (Concept)
Domain of coverage	Air-ground	Air-ground, Ground-ground	Ground-ground	Air-ground, Ground-ground
Range of services	End-to-end	End-to-end	SDP-to-SDP	End-to-end
Top ISO/OSI Reference Model layer addressed	Application	Application	Network	Session
Protocol base	Proprietary message-switching	Modified OSI	IPv4	IPv4, IPv6
Networking industry support	Minimal	Minimal	Widespread	Widespread
Security capabilities	None	Planned	Network-level	End-to-end
Risks	Security, reliability, performance	Costs, security, expertise, scalability, commonality, certification	Security, commonality	Certification

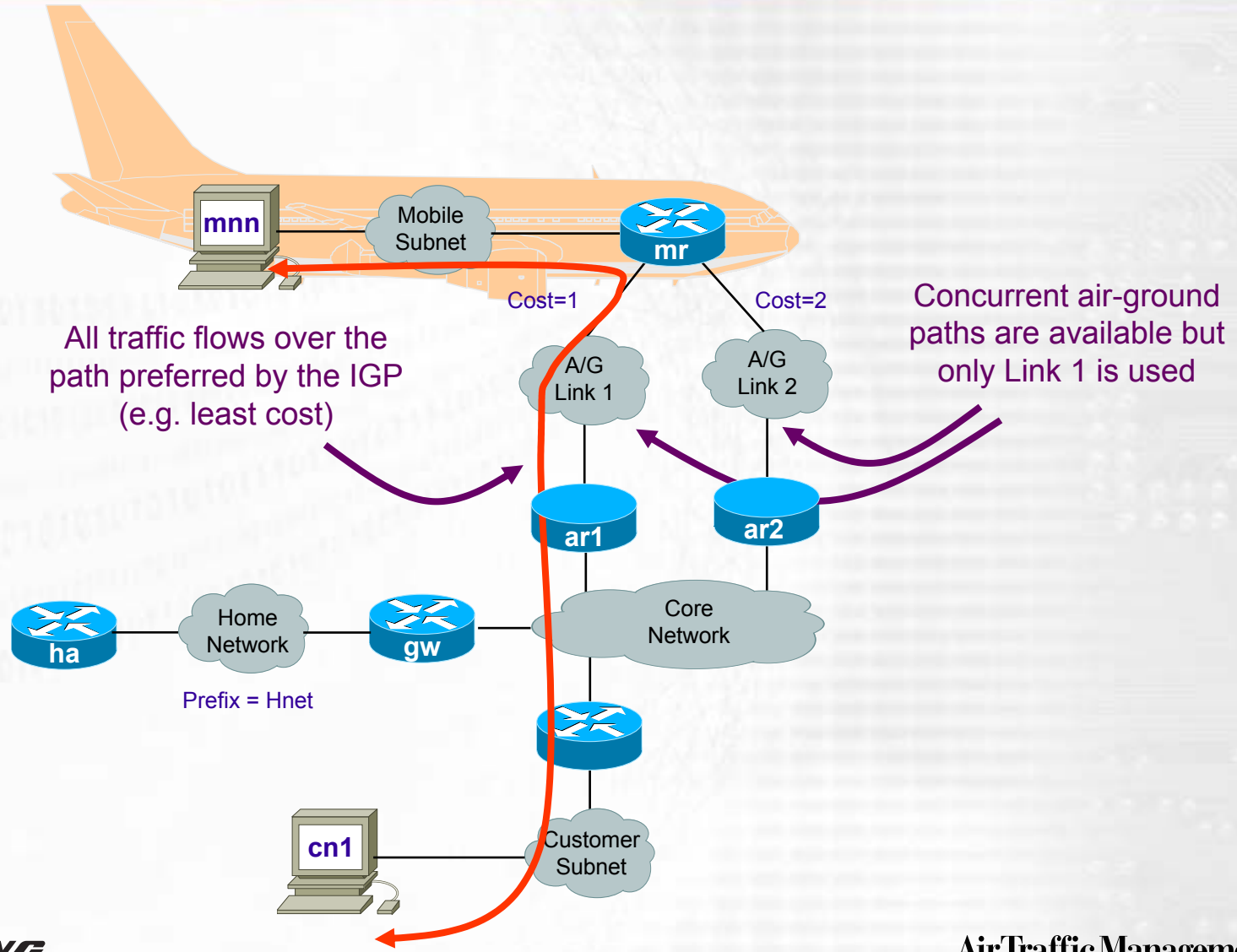
Primary architectural considerations

- Airborne elements: limited air-ground bandwidth, multiple DLSPs, mobility
- Safety of flight: ultra-high availability
- Multiple voice & data services: service quality
- Globally accessible: space-based infrastructure
- Scale: 100K's of aircraft and K's of terrestrial nodes
- Security: authentication, confidentiality, integrity, attack-resistance, authorization, access control, key management
- Legacy compatibility: avionics retrofits very expensive
- Multiple levels of onboard equipage

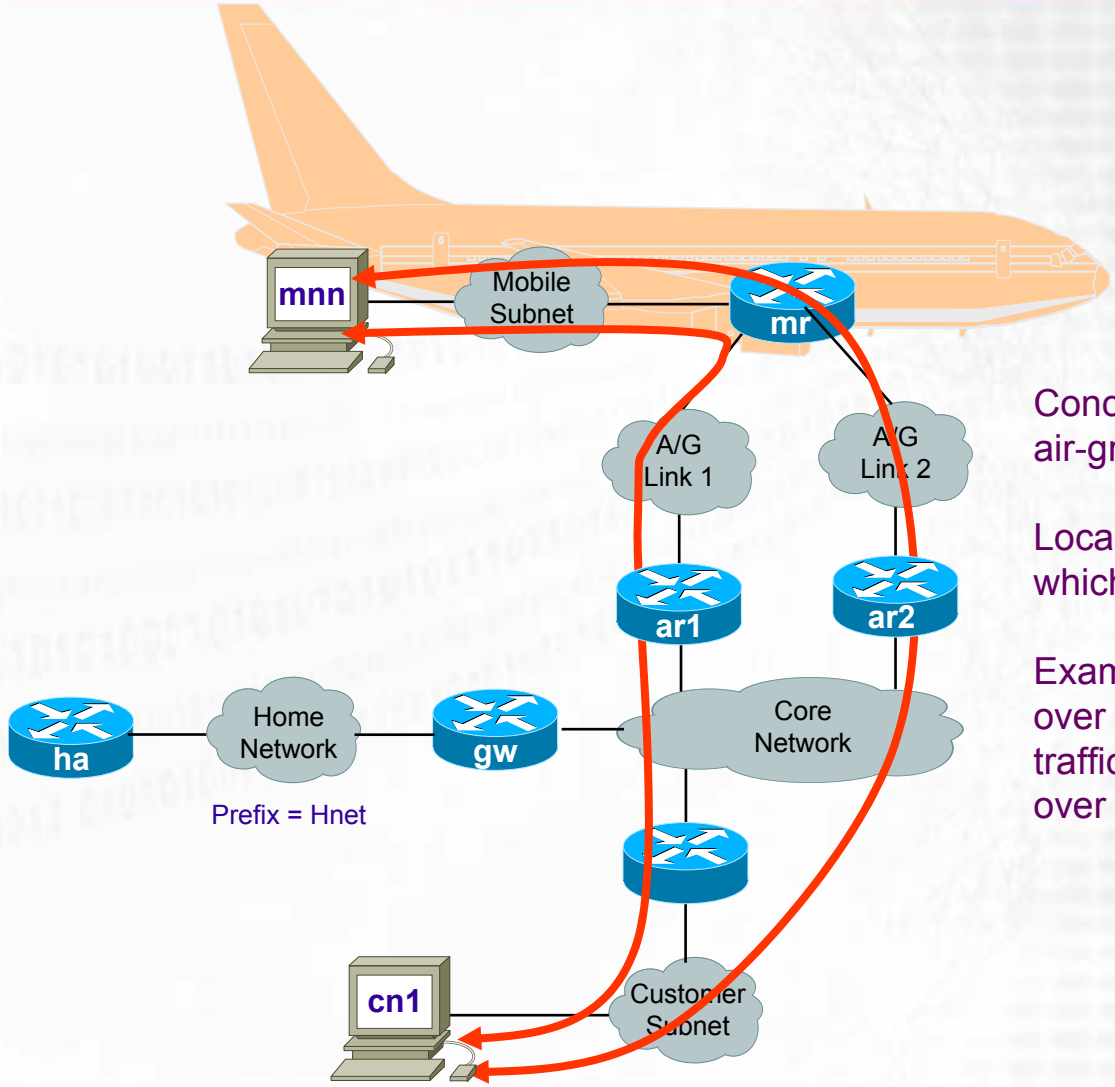
Architectural concepts – multi-homed mobility



Architectural concepts – conventional routing



Architectural concepts – policy-based routing

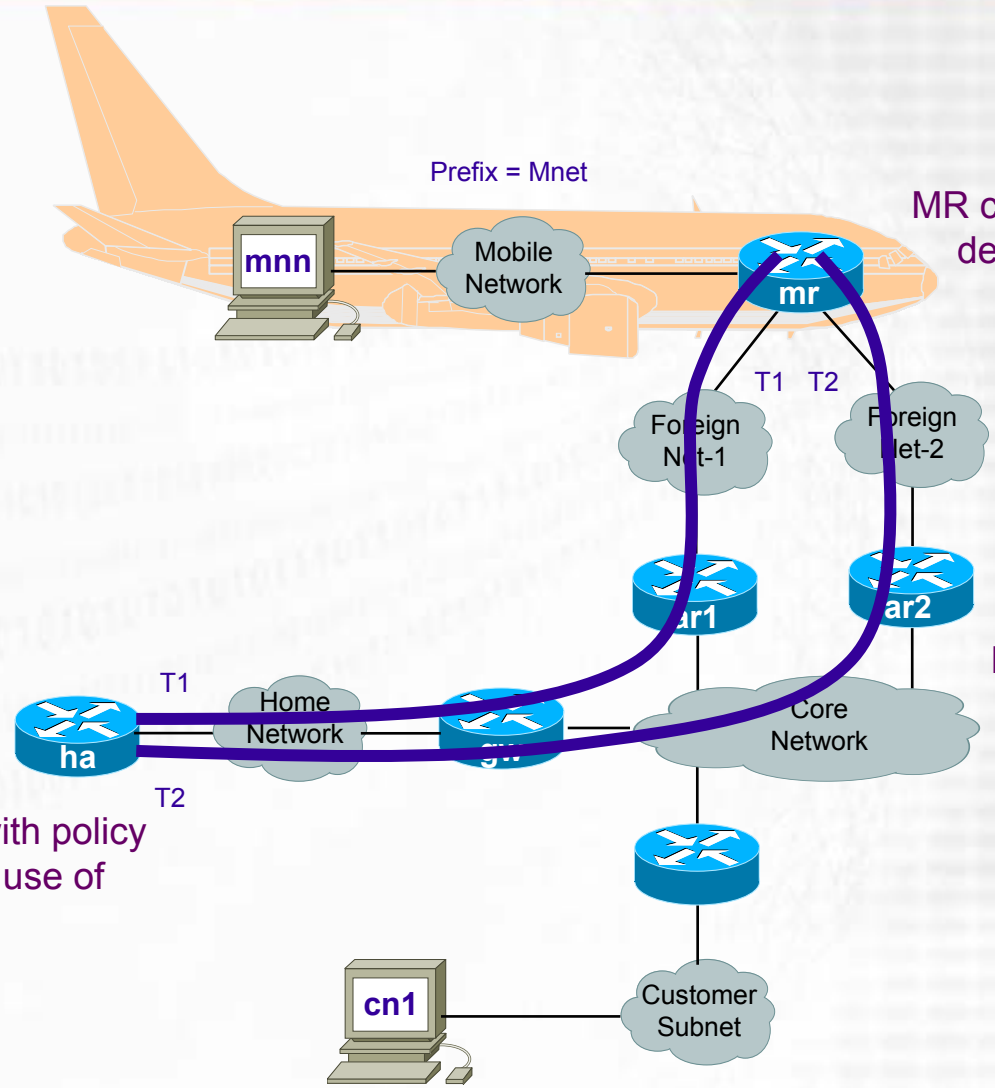


Concurrent communication over multiple air-ground data links

Local routing policy on MR determines which data link (path) traffic will take

Example: Safety of life traffic is routed over A/G Link 1 while routine business traffic Is simultaneously routed over A/G Link 2

Architectural concepts – potential policy-based routing implementation scenario

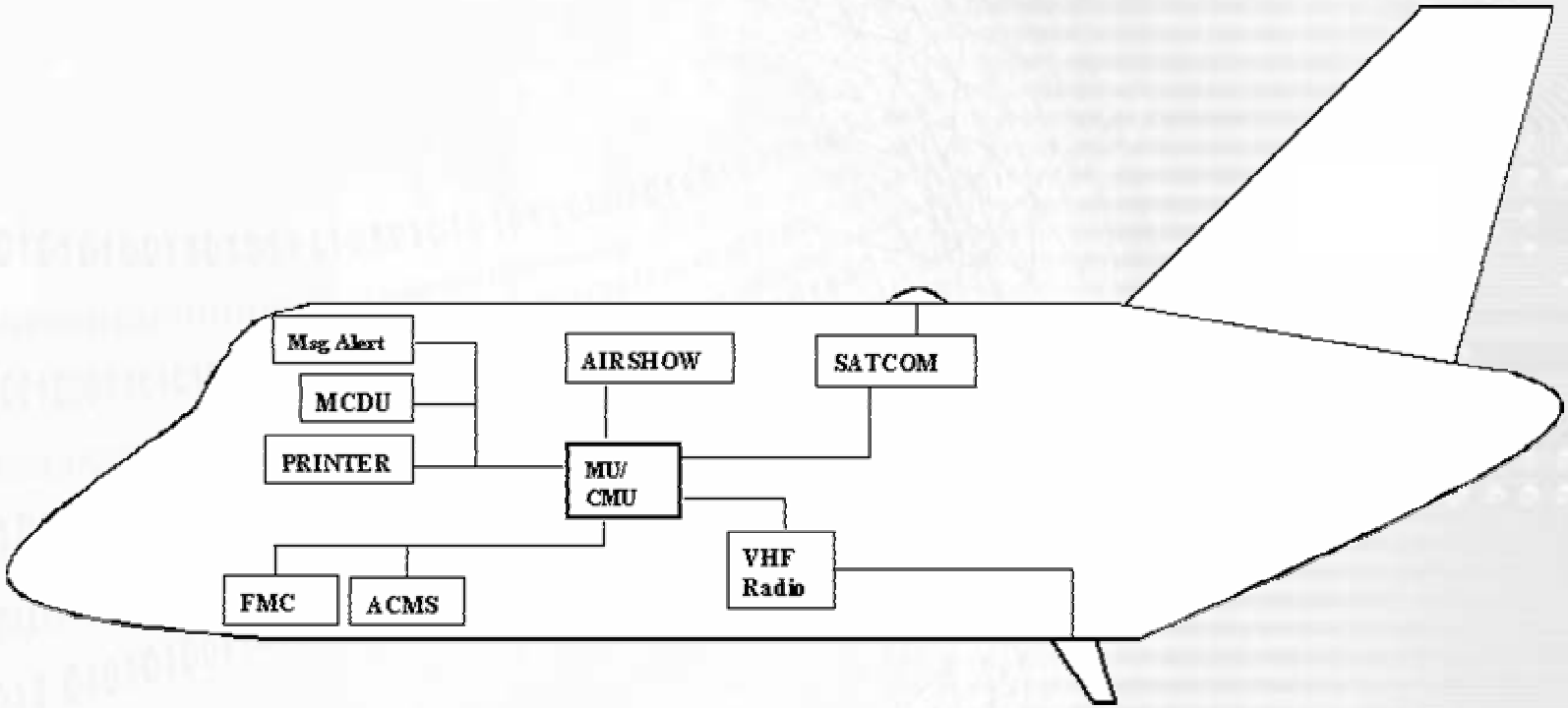


MR configured with policy definitions for use of reverse tunnels

Note: Policy only needs to be Defined at the tunnel endpoints

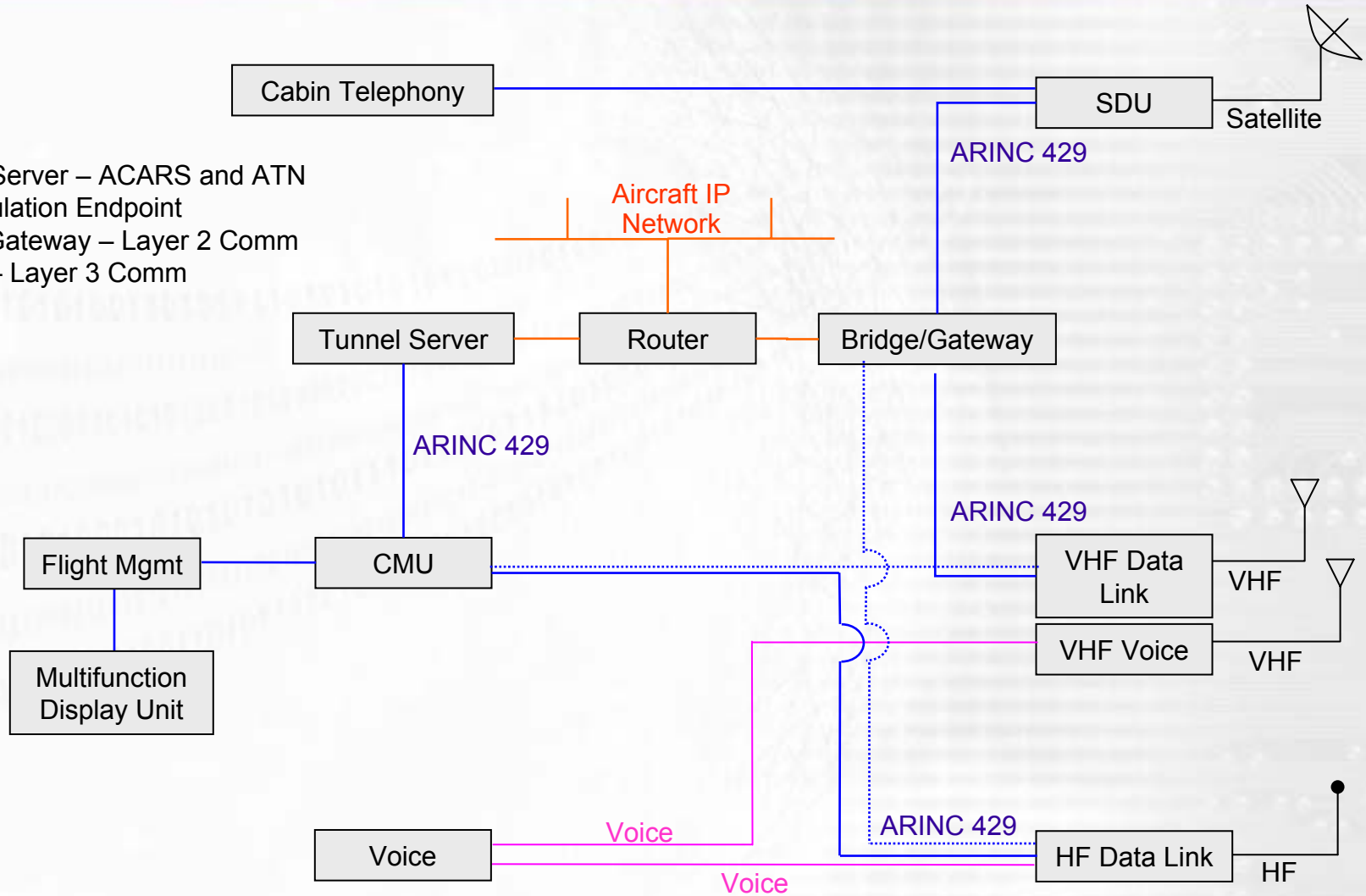
HA configured with policy definitions for use of tunnels

Architectural concepts – current airborne network

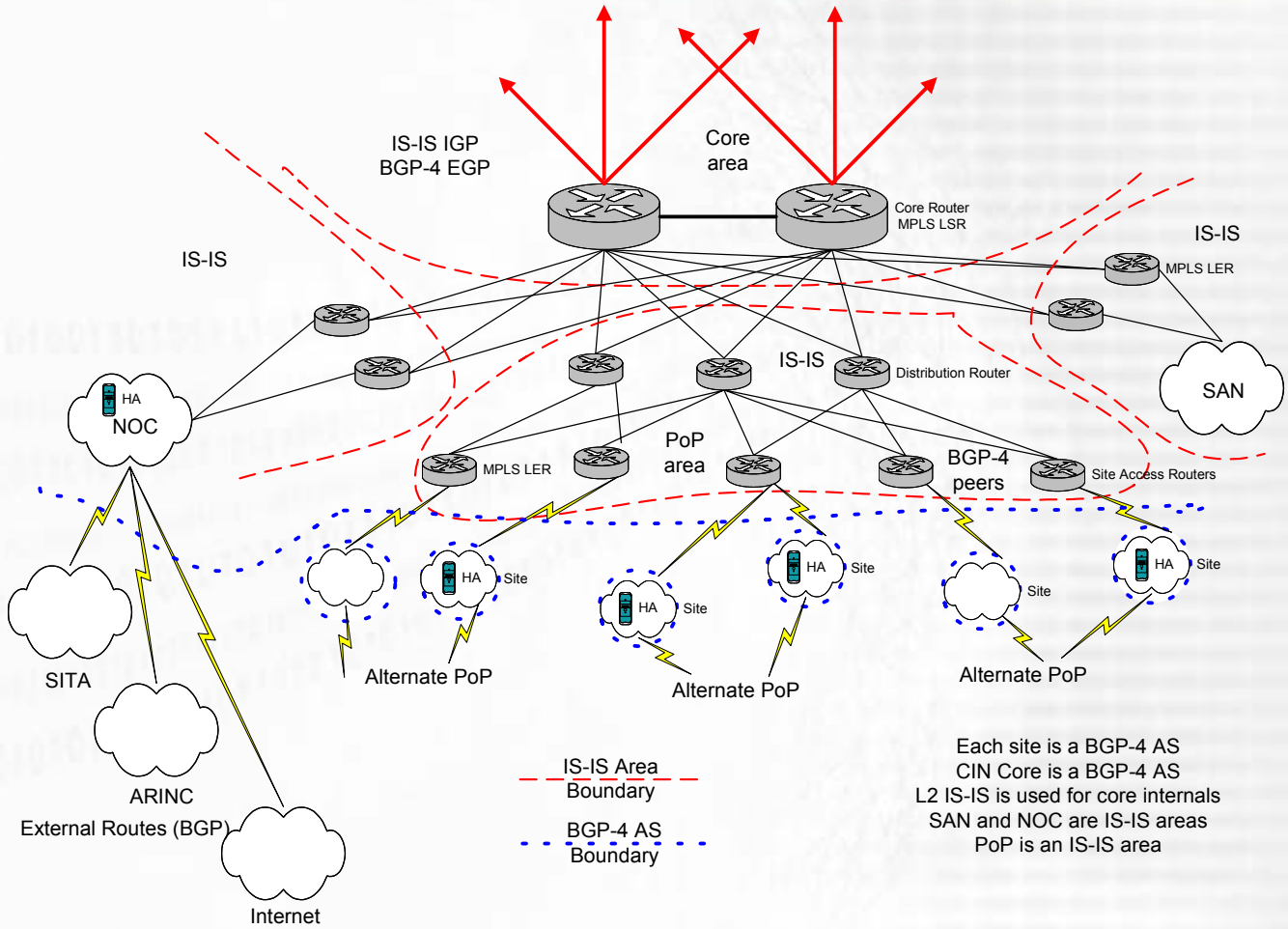


Architectural concepts – onboard network

- Tunnel Server – ACARS and ATN Encapsulation Endpoint
- Bridge/Gateway – Layer 2 Comm
- Router – Layer 3 Comm

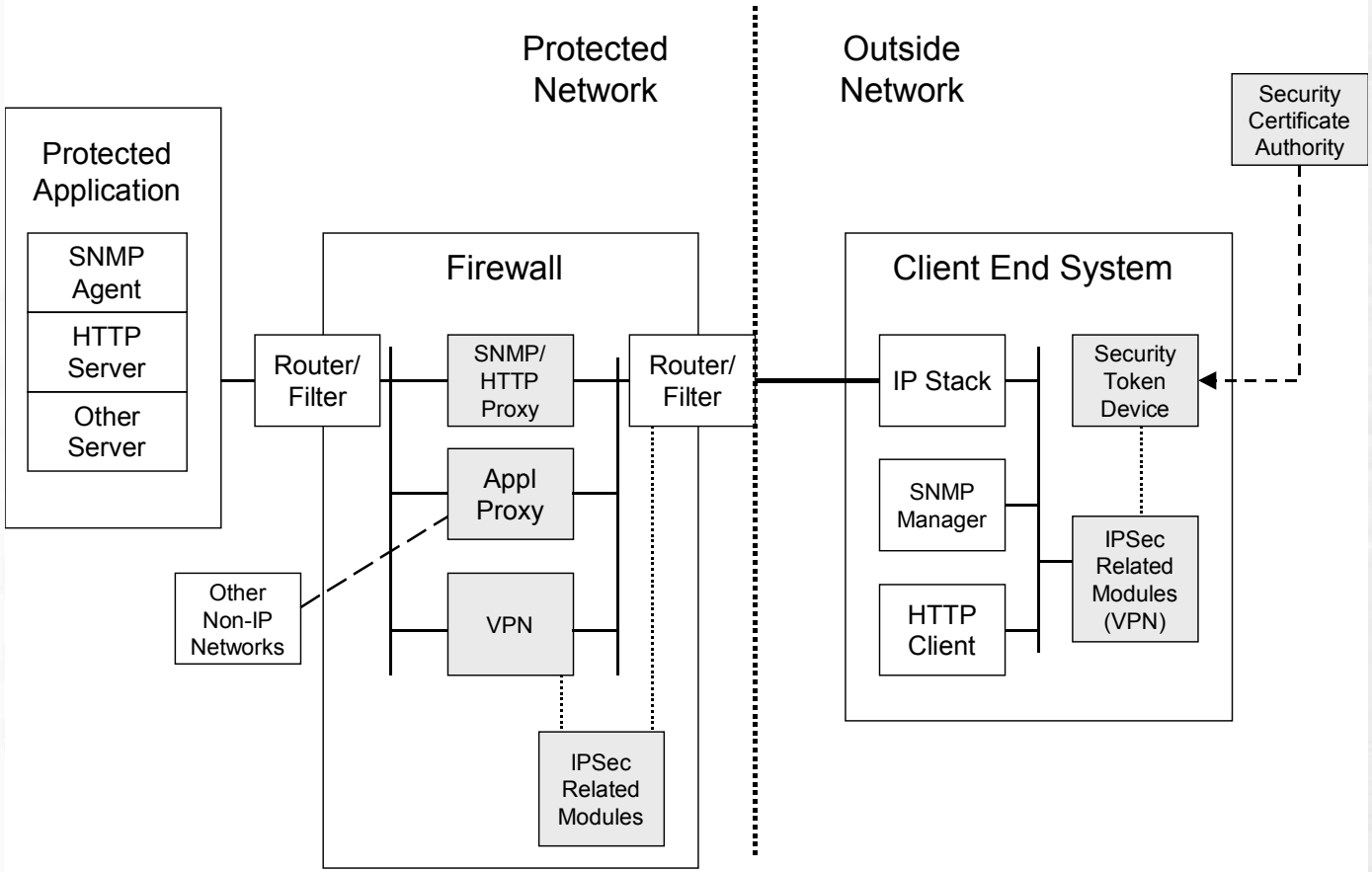


Architectural concepts – terrestrial network



➔ ***Widely-used standards and technologies!***

Architectural concepts – security reference model



➔ ***Widely-used standards and technologies!***

Final thoughts

- There are significant issues with current and proposed approaches to ATM communications services
- Resistance to change does not help
- An Internet Protocol standards-based approach to end-to-end ATM communications leverages the efforts of thousands of developers worldwide